

# SNO: Energy Calibration using $^{16}\text{N}$

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The  $\gamma$ -rays resulting from the radioactive decay of  $^{16}\text{N}$  will be used to provide an energy calibration of the Sudbury Neutrino Observatory (SNO). Each decay results in the emission of a  $\beta^-$ , while 74% of decays have a high energy  $\gamma$ -ray of either 6.1 MeV (68%) or 7.1 MeV (6%). A gas transport system has been developed to produce  $^{16}\text{N}$  and transfer it to our tagged decay chamber. The stainless steel decay chamber contains a smaller cylindrical shell of plastic scintillator, inside which the majority of  $^{16}\text{N}$  decays occur. The  $^{16}\text{N}$   $\beta$ s produce a trigger signal in the scintillator, used to trigger the SNO PMT array.

A detailed representation of the  $^{16}\text{N}$  decay chamber has been incorporated into SNOMAN, the Monte Carlo simulation of SNO (Figure 1). The external container (CAN) is modeled as a solid cylinder, in which the other geometry regions are embedded. The upper (INSTR) and lower (GAP) chambers are separated by a stainless steel annulus (RING). The center of the annulus contains an acrylic optical window (OPT), through which light passes from the scintillator (SCINT) to the PMT. The decay of  $^{16}\text{N}$  is primarily restricted to the GAS region. We have neglected the thin capillary which delivers the  $^{16}\text{N}$  gas to the lower chamber.

The number of phototubes which observe Čerenkov light (NHIT) help establish the energy calibration of SNO. Our simulations of  $^{16}\text{N}$  energy calibration have focussed on the influence of the decay chamber on the  $\beta$  and  $\gamma$ -rays. Ideally, there would be no contribution to NHIT from the  $\beta$ , while the  $\gamma$ -rays would be completely unaffected by the material of the decay chamber. SNO's energy calibration would then be determined by the  $^{16}\text{N}$   $\gamma$ -rays of 6.1 MeV and 7.1 MeV.

In practice, there will be attenuation of the  $\gamma$ -rays, which will shift the mean to lower val-

ues and broaden the peak of the NHIT distribution. There will also be optical shadowing of the Čerenkov light by the decay chamber. Finally,  $\beta$ s will be capable of producing bremsstrahlung radiation as a result of interactions in the decay chamber. These processes have been carefully studied through use of the SNOMAN Monte Carlo simulations and have been supplemented by experiment with  $\gamma$ -ray sources.

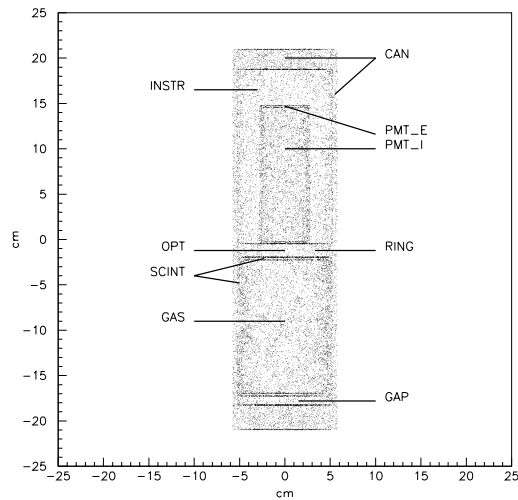


Figure 1: This is a map of the boundaries of the geometry regions of the  $^{16}\text{N}$  decay chamber.

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